APPENDIX C

AIR QUALITY DATA

C-1. Emissions Inventory Assumptions and Calculations

This appendix documents the existing and proposed sources of air pollutants, emissions factors and assumptions used to derive the quantity of emissions for each pollutant. These calculated emissions levels were used in dispersion modeling to obtain conservative estimates of air quality impacts for the proposed action as well as cumulative impacts due to other sources in the area.

Table C-1 lists the existing permitted sites showing the major types, sizes, and models of existing equipment currently installed and operated by Inland in the vicinity of the proposed project area. Impacts due to these units are specifically included in the assessment of impacts for the proposed project.

Table C-1
Inland Permitted Existing Sites

		Annual Emissions (ton/yr)					Emission Factors (g/bhp-hr)				
Site Name	**Equipment**	**VOCs[1]**	**NO_X**	**SO_2**	**CO**	**PM_{10}**	**VOCs**	**NO_X**	**SO_2**	**CO**	**PM_{10}**
Monument Butte											
Liquids Conditioning Plant											
	Waukesha 3521G	0.0	1.2	0.0	1.2	0.0	2.5E-03	4.0E-01	2.1E-03	4.0E-01	2.2E-03
	Glycol Heater		0.3		0.1	0.0		7.1E-02		1.7E-02	8.5E-03
Compressor Station											
Four 1050 hp	Cat 3516-LE	32.0	81.0	0.1	68.9	0.0	2.5E-03	2.0E+00	2.1E-03	1.7E+00	2.2E-03
Ashley											
Existing	Cat 3516-LE 1050 hp	16.5	59.0	0.5	50.1	4.8	2.5E-03	2.0E+00	2.1E-03	1.7E+00	2.2E-03
	Glycol Dehydration										
Expansion											
Odekirk											
Three 1050 hp	Cat 3516-LE 1050 hp	12.0	60.8	0.0	48.6	1.1	2.5E-03	2.0E+00	2.1E-03	1.6E+00	2.2E-03
	Glycol Dehydration										
Inland											
320 bhp	Waukesha 3521 G	0.0	1.2	0.0	1.2	0.0	2.5E-03	2.8E-01	2.1E-03	2.8E-01	2.2E-03
123 bhp	MM HD100M-6A	0.0	0.9	0.0	0.9	0.0	2.5E-03	2.0E-01	2.1E-03	2.0E-01	2.2E-03
Water Injection Pumps											
4 ea 325 bhp	Cat 3406-LE 325 hp	48.0	25.1	0.0	21.3	0.0	2.5E-03	2.0E+00	2.1E-03	1.7E+00	2.2E-03
Total		108.5	229.6	0.6	192.3	6.0					

[1]Values less than 0.01 tpy show as 0.0

Table C-2 summarizes the existing and proposed development including existing and proposed wells, surface disturbance areas, access roads, production of oil, as well as categories of vehicles and number of miles driven annually within the proposed project area. The footnotes show the assumptions made to develop the conservative estimates of emissions used to evaluate the project impact on the environment in the vicinity of the project and within the region.

Table C-3 shows the emission factors developed for the proposed project and lists the annual emissions of each of the criteria pollutants that would be emitted in significant quantities due to the existing and proposed project. The inventory includes emissions from construction activities that would occur during development. Emissions for operations are based on the assumption that all potential wells would be drilled and in full production.

Table C-2
Summary of Development and Surface Disturbance

Development and Disturbance	Existing	Proposed Action	Total
Total Producing/Injection Wells	671	973	1644
Producing Oil Wells	336	487	823
Plugged/non-Producing Wells	24	34	58
Active Injection Wells	335	486	821
Total Active Wells	647	939	1586
Well Pad Surface Disturbance Area (acres)	1678	2433	4110
Reclaimed Surface Disturbance	60	85	145
Access Roads (miles)	101	146	247
Access Roads (acres)	305	442	747
Oil produced per year (bbl)	1,330,644	1,928,642	3,259,286
Oil Tanker VMT/year	76,768	111,268	188,036
Water Tanker VMT/year	33,369	48,366	81,735
Service Vehicles VMT/day	2,547	3,693	6,240
Service Vehicles VMT/year	929,533	1,347,893	2,277,426

Assumptions:

ROW 25ft (acres/mi)	3.03
Access Road 0.15 mi/well	0.15
Oil removed 260 bbl per tuck load	260
Tanker travel on access roads per load (mi)	15
Average oil production bbl per day	10.9
Temperature of oil tanks 157°F	157

Proposed Action may result in as many as 933 oil and injection wells.

Fugitive dust from unpaved roads in the proposed project area is the largest single type of source for PM_{10}. Emissions from unpaved roads are subject to some natural mitigation because of rainfall and other precipitation. Annual average uncontrolled emissions with natural mitigation due to rainfall are inversely proportional to the number of days with measurable (more than 0.254 mm [0.01 inch]) precipitation. The following equation from AP42 is the basis for calculating emissions factors for fugitive particulates due to traffic on unpaved roads:

$$Eext = \{k \times (s/12)^a (W/3)^b)/[(Mdry/0.2)^c]\} \times [(365 - p) /365]$$

Where:
Eext = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
s = surface material silt content (%)
W = mean vehicle weight (tons)
Mdry = surface material moisture content under dry, uncontrolled conditions, percent
p = number of days with at least 0.254 mm (0.01 in) of precipitation per year.

And k, a, b, and c are defined in Table C-4.

Table C-3
Air Emissions Inventory for Proposed Castle Peak and Eightmile Flat Project

Process	Number of Units	Emission Factors (ton/unit/yr)					Annual Emissions (ton/yr)				
		VOCs	NO_x	SO_2	CO	PM_{10}	VOCs	NO_x	SO_2	CO	PM_{10}
Drilling (Each Year)[1]	130	3.48E-01	4.37E+00	2.89E-01	9.42E-01	3.10E-01	45	568	38	122	40
Production (Final Buildout)											
Existing											
Tank heaters	649	1.47E-02	1.84E-01	1.11E-03	3.87E-02	2.21E-02	10	120	1	25	14
Line Heaters	158	1.11E-02	1.38E-01	8.29E-04	2.90E-02	1.66E-02	2	22	0	5	3
Heater Treaters	336	4.42E-02	5.53E-01	3.32E-03	1.16E-01	6.63E-02	15	186	1	39	22
Oil Tanks	672	5.00E-01					336				
Water Tanks	336										
New											
Tank heaters	974	1.47E-02	1.84E-01	1.11E-03	3.87E-02	2.21E-02	14	179	1	38	22
Line Heaters	200	1.11E-02	1.38E-01	8.29E-04	2.90E-02	1.66E-02	2	28	0	6	3
Heater Treaters	487	4.42E-02	5.53E-01	3.32E-03	1.16E-01	6.63E-02	22	269	2	57	32
Oil Tanks	974	5.00E-01					487				
Water Tanks	487										
Pump drivers											
Existing	410	1.54E-01	3.89E+00	0.00E+00	5.36E-01	5.72E-02	63	1,595	0	220	23
New	487	1.54E-01	3.89E+00	0.00E+00	5.36E-01	5.72E-02	75	1,894	0	261	28
Pernitted Compressors, WI pumps, etc.											
Existing		2.02E+01	6.75E+01	1.63E-01	5.63E+01	1.97E+00	108	230	1	192	6
Vehicles (VMT) - existing											
Oil tankers	76,768	4.41E-06	7.71E-06	3.01E-07	3.30E-05	1.99E-04	0	1	0	3	15
Water trucks	33,369	4.41E-06	7.71E-06	3.01E-07	3.30E-05	1.70E-04	0	0	0	1	6
Pickups, service vehicles	929,533	4.41E-06	7.71E-06	3.01E-07	3.30E-05	1.17E-05	4	7	0	31	11
Vehicles (VMT) - new											
Oil tankers	111,268	4.41E-06	7.71E-06	3.01E-07	3.30E-05	1.99E-04	0	1	0	4	22
Water trucks	48,366	4.41E-06	7.71E-06	3.01E-07	3.30E-05	1.70E-04	0	0	0	2	8
Pickups, service vehicles	1,347,893	4.41E-06	7.71E-06	3.01E-07	3.30E-05	1.17E-05	6	10	0	45	16
Total Project							1,190	5,109	44	1,049	272
Total New							652	2,950	41	533	171
Total Existing							538	2,159	3	515	101
Total							1,190	5,109	44	1,049	272
New without drilling							607	2,382	3	411	131
Total without drilling							1,145	4,541	6	926	232

[1]Emission Factors from AP42 assumes 2 each, 500 hp diesel engines, 25 days per well at 0.47 capacity.

Assumptions:
- Proposed Action may result in as many as 973 oil and injection wells.
- Compressor stations same as existing.
- Tanks at well sites consist of 2 each 400 bbl oil and 1 each 200 bbl water tank.
- Tanks at compressor stations consist of 2 each 400 bbl condensate and 1 each 90 bbl water tank.
- Oil removed at 260 barrels per load.
- Average oil production 10.85 bbl per day per well.
- Temperature of oil tanks 157°F.
- Tank heaters = 0.5 MMBtu.
- Line heaters = 0.375 MMBtu.
- Heater treaters = 1.5 MMBtu.
- Fleet fugitive dust (See fugitive).
- Fleet average SO_2 = 0.273 g/mi.
- Fleet average CO = 30 g/mi.
- Fleet average NO_x = 7 g/mi.
- Fleet average HC = 4 g/mi.
- Heat value of gas is 1189 Btu/cubic-ft.
- Small boiler emission factors (natural gas):
  - VOCs = 8 lb/MM cubic feet
  - NO_x = 100 lb/MM cubic feet
  - SO_2 = 0.6 lb/MM cubic feet
  - CO = 21 lb/MM cubic feet
  - PM_{10} = 12 lb/MM cubic feet
- Pump drivers are 37 hp natural gas engines.
- Water injection pumps are 1,050 hp natural gas engines.

Table C-4
Constants for Above Equation

Constant	$PM_{2.5}$	PM_{10}	PM_{30}[a]
k (lb/VMT)	0.38	2.6	10
A	0.8	0.8	0.8
B	0.4	0.4	0.5
C	0.3	0.3	0.4

[a]Assumed equivalent to total suspended particulate (TSP).

Source: USEPA Compilation of Air Pollutant Emission Factors (AP42), 1995.

C-2. Impacts Assessment and Modeling Assumptions

Fugitive dust from unpaved roads in the region created by pickups, field service vehicles, tankers, and water trucks is expected to be the largest single source type. Other types of emissions in the proposed project area include vehicles, drilling rigs, tanks, and other fugitive non-point sources. Using the emissions inventory described above, SCREEN3 modeling was performed to characterize all such emissions as coming from area sources. Area sources as used in this modeling do not have a single release point (stack) and are assumed to be at ambient temperature. Emissions were characterized as having no initial vertical velocity with an assumed release height of 10 meters.

The USEPA SCREEN3 dispersion model was used with full meteorological data. This model was used to predict maximum potential concentrations based on the most conservative meteorological assumptions of stability and wind speed. The resultant concentrations (impacts) predicted by the model are based on the weakest potential of the atmosphere to dilute pollutants resulting in highest conservative estimates of concentrations for each pollutant. A sample of SCREEN3 model output is attached.

SCREEN3 Model outputs are for 1-hour averages. To convert SCREEN3 1-hour results to values for longer periods, the following factors are applied:

Period	Conversion Factor
3-hour	0.9
8-hour	0.7
24-hour	0.4
Annual	0.08

For cumulative impact analysis, existing and proposed sources in the analysis area were characterized as area sources. Maximum impacts of the proposed project were shown to occur approximately 10 miles from the project area. The highest concentrations modeled were added to the background concentrations for each pollutant provided by Utah Bureau of Air Quality and then added to the concentrations predicted by regional modeling for the Vernal RMP analysis (Table C-5). The Vernal RMP modeling analysis was also used to predict impacts at distant mandatory federal PSD Class I area, for comparison with applicable air quality standards, HAP exposures, visibility and atmospheric deposition impacts.

Table C-5
Cumulative Impacts Compared to NAAQS

Pollutant	Averaging Period	Project Impacts ($\mu g/m^3$)	Background ($\mu g/m^3$)	Vernal RMP Analysis ($\mu g/m^3$)	Total Predicted Project, Background, and RMP ($\mu g/m^3$)	Ambient Air Quality Standard ($\mu g/m^3$)
Sulfur dioxide	Annual	0.22	5	0.19	5	80
	24-hour	1.09	10	3.10	14	365
	3-hour	2.45	20	15.90	38	1,300
Nitrogen dioxide	Annual	18.17	10	1	29	100
Carbon monoxide	8-hour	46.91	1,150	4	1,201	10,000
	1-hour	67.02	1,150	9	1,226	40,000
PM_{10}	Annual	1.46	10	0.34	12	50
	24-hour	7.30	28	3.40	39	150
$PM_{2.5}$	Annual	0.37	7	0.14	8	15
	24-hour	1.83	19	0.74	22	65

Sample output from SCREEN3 modeling

```
10/17/02

10:49:38
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***

 NOx New Sources With Drilling

 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE                =         AREA
    EMISSION RATE (G/(S-M**2))  =      .305000E-06
    SOURCE HEIGHT (M)          =      10.0000
    LENGTH OF LARGER SIDE (M)   =   32000.0000
    LENGTH OF SMALLER SIDE (M)  =    8000.0000
    RECEPTOR HEIGHT (M)        =        .0000
    URBAN/RURAL OPTION         =        RURAL
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

    MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION


 BUOY. FLUX =     .000 M**4/S**3;  MOM. FLUX =     .000 M**4/S**2.

 *** FULL METEOROLOGY ***

 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************

 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES
***

   DIST     CONC             U10M   USTK  MIX HT   PLUME  MAX DIR
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
 -------  ----------  ----  -----  -----  ------  ------  -------
     50.   105.9        6     1.0    1.0 10000.0   10.00     10.
    100.   106.1        6     1.0    1.0 10000.0   10.00     10.
    200.   106.5        6     1.0    1.0 10000.0   10.00     10.
    300.   107.0        6     1.0    1.0 10000.0   10.00     10.
    400.   107.4        6     1.0    1.0 10000.0   10.00     10.
    500.   107.8        6     1.0    1.0 10000.0   10.00     10.
    600.   108.2        6     1.0    1.0 10000.0   10.00     10.
    700.   108.7        6     1.0    1.0 10000.0   10.00     10.
    800.   109.1        6     1.0    1.0 10000.0   10.00     10.
    900.   109.5        6     1.0    1.0 10000.0   10.00     10.
   1000.   110.0        6     1.0    1.0 10000.0   10.00     10.
   1100.   110.4        6     1.0    1.0 10000.0   10.00     10.
   1200.   110.8        6     1.0    1.0 10000.0   10.00     10.
   1300.   111.2        6     1.0    1.0 10000.0   10.00     10.
   1400.   111.6        6     1.0    1.0 10000.0   10.00     10.
   1500.   112.1        6     1.0    1.0 10000.0   10.00     10.
   1600.   112.5        6     1.0    1.0 10000.0   10.00     10.
   1700.   112.9        6     1.0    1.0 10000.0   10.00     10.
```

1800.	113.3	6	1.0	1.0	10000.0	10.00	10.
1900.	113.7	6	1.0	1.0	10000.0	10.00	10.
2000.	114.1	6	1.0	1.0	10000.0	10.00	10.
2100.	114.6	6	1.0	1.0	10000.0	10.00	10.
2200.	115.0	6	1.0	1.0	10000.0	10.00	10.
2300.	115.4	6	1.0	1.0	10000.0	10.00	10.
2400.	115.8	6	1.0	1.0	10000.0	10.00	10.
2500.	116.2	6	1.0	1.0	10000.0	10.00	10.
2600.	116.6	6	1.0	1.0	10000.0	10.00	10.
2700.	117.0	6	1.0	1.0	10000.0	10.00	10.
2800.	117.4	6	1.0	1.0	10000.0	10.00	10.
2900.	117.8	6	1.0	1.0	10000.0	10.00	10.
3000.	118.2	6	1.0	1.0	10000.0	10.00	10.
3500.	120.1	6	1.0	1.0	10000.0	10.00	9.
4000.	122.1	6	1.0	1.0	10000.0	10.00	9.
4500.	124.1	6	1.0	1.0	10000.0	10.00	9.
5000.	126.0	6	1.0	1.0	10000.0	10.00	9.
5500.	128.0	6	1.0	1.0	10000.0	10.00	9.
6000.	129.9	6	1.0	1.0	10000.0	10.00	9.
6500.	131.8	6	1.0	1.0	10000.0	10.00	9.
7000.	133.7	6	1.0	1.0	10000.0	10.00	9.
7500.	134.5	6	1.0	1.0	10000.0	10.00	6.
8000.	136.4	6	1.0	1.0	10000.0	10.00	6.
8500.	138.3	6	1.0	1.0	10000.0	10.00	6.
9000.	141.2	6	1.0	1.0	10000.0	10.00	11.
9500.	142.7	6	1.0	1.0	10000.0	10.00	12.
10000.	144.5	6	1.0	1.0	10000.0	10.00	12.
15000.	162.0	6	1.0	1.0	10000.0	10.00	4.
20000.	140.5	6	1.0	1.0	10000.0	10.00	11.
25000.	124.9	6	1.0	1.0	10000.0	10.00	9.
30000.	115.6	6	1.0	1.0	10000.0	10.00	6.
40000.	104.7	6	1.0	1.0	10000.0	10.00	0.
50000.	98.10	6	1.0	1.0	10000.0	10.00	0.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 50. M:

16240.	166.2	6	1.0	1.0	10000.0	10.00	10.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
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CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	166.2	16240.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****